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DIVERSE TOPICS.

THE ORIGIN OF THOUGHT-FORMS.

DR. H. POTONIÉ, the editor of the *Naturwissenschaftliche Wochenschrift*, Berlin, advances in one of its recent numbers (Vol. vi. 15) the following proposition concerning the origin of the forms of thought: "All the forms of thought have originated in the struggle for life not otherwise than the forms of organisms." This is further explained in the following sentence: "Those conceptions which are called *a priori*, are inherited; they have been necessarily used by the primitive thinking organisms and are now in their disposition immediately present. Yet they have been gained by experience. Without any knowledge, for instance, of space and time, no action is possible; accordingly their conception is perhaps the oldest and therefore it appears aprioristic."

I. THOUGHT-FORMS AND THE FORMS OF EXISTENCE.

We agree with Dr. Potonié that thought-forms grow naturally and that they grow such as they are, of necessity. In our opinion formal thought, with its so-called *a priori* theorems, is derived from the thought-forms by abstraction. (See "Fundamental Problems" pp. 26–60, the chapter Form and Formal Thought.) If it had been possible for other thought-forms to have originated together with those which we possess at present, and it may be parenthetically remarked that we do not consider it as possible; but *if* it had been possible, we do not deny that all the other thought-forms would have gone to the wall, they would have perished in the struggle for existence and our present thought-forms alone would have survived. In this we agree with Dr. Potonié, and a naturalist may be satisfied with this statement, because it suffices for his purposes. The recognition of the objective validity of the laws of formal thought is all that the specialist wants for this or that branch of science. But this recognition is not sufficient for the philosopher. He has to understand the problem why the subjective laws of purely formal thought possess an absolute and an objective validity for the world of real existences. He must understand not only how thought-forms originated, but also why and on what ground the laws of formal thought are considered as necessary and universal truths. The question of their origin and growth is of secondary importance compared with the question of their rigidity and apriority.

Mr. Herbert Spencer has made the same proposition as Dr. Potonié and his view briefly expressed is this: "The laws of formal thought are *a priori* to the individual, but *a posteriori* to the race." In other words apriority must be explained by heredity. A dog cannot count, because none of his ancestors have ever counted, but a child has the faculty to learn counting because innumerable ancestors of his have counted and his brain possesses a predisposition to learn counting easily. Concerning our apprehension of space-relations which expressed as mathematical theorems appear to us necessary and are called *a priori*, Mr. Spencer says:

> "We cannot think otherwise because during that adjustment between the organism and the environment which evolution has established, the inner relations have been so moulded upon the outer relations that they cannot by any effort be made not to fit them. Just in the same way that an infant's hand, constructed so as to grasp by bending the fingers inwards, implies ancestral hands which have thus grasped, and implies objects in the environment to be thus grasped by this infantine hand when it is developed, so the various structures fitting the infant for apprehension of space-relations, imply such apprehensions in the past by its ancestors and in the future by it self."

Man's ability to learn counting is inherited, and there may be more or less of it in different people. Mathematical talent is inherited just as much as musical talent or other faculties. But the philosophical question concerning the apriority of mathematical theorems has nothing whatever to do with the origin of mathematical talent. When Mr. Spencer declares that apriority is but an inherited aposteriority, this is equivalent and is intended to be equivalent to an actual denial of all apriority. His very explanation proves that he does not see the real problem, and in the same way Dr. Potonié overlooks it entirely. The philosophical problem of the apriority is not an historical problem, it cannot be solved by tracing the evolution of thought-forms. The philosopher does not ask how did thought-forms originate, but why do we attribute to the laws of formal thought necessity and universality and on what ground can we justify our assumption?

Mr. Spencer compares our apprehension of space-relations to our inherited habit to grasp with our hands and to walk with our feet. This comparison is misleading and inappropriate. That we grasp with our hands and walk with our feet is incidental. There are animals who have developed other limbs for the same purposes. There are monkeys who grasp with their tails and the elephant grasps with his nose. There is no necessity and no universality in our predisposition of grasping with our hands. Yet there resides necessity and universality in the laws of formal thought so that wherever animals develop rational thought we are sure that to them twice two will always equal four just as much as it does to us. However they may be different in other respects: they may be winged creatures or may be somewhat like our ants, they may have developed other bodily structures than we can dream of, nevertheless their arithmetic, their logic, and their mathematics will in all essentials be exactly the same as ours. There are animals whose thought-forms are not as highly developed as in man, but there are no animals in whom they are developed differently. We must consider it as impossible even that on other stars rational creatures can be found whose reason differs from ours. To them also twice two will be four.

II. THE PROBLEM OF APRIORITY.

Kant did not call the formal laws *a priori* in order to characterise them as innate ideas, but simply to denote that their validity is necessary and universal. If I have to walk twice a distance of two miles, I know "beforehand" (i. e. *a priori*) that I shall have to walk four miles—even before I have made the actual experience. And this wonderful quality of giving information beforehand is characteristic of all the laws of formal thought. It is certain that our ability of applying the laws of formal thought has been acquired by experience in the race as well as in the individual. But their necessity has to do with experience in so far only as its recognition is the indispensable condition of all methodical experience—i. e. of science. The laws of formal thought and our recognition of their necessity and universality (alias, "apriority") are the organ of any and all scientific cognition. The methods of the sciences are exact measuring and counting based upon the faith that the laws of measuring and counting are unalterable and unfailingly reliable. We know beforehand that they will hold good for all possible cases.

Our experience of millenniums suffices to prove that the laws of formal thought agree with the laws of actual existence, and Kant's view to consider them as merely subjective and not objective appears to me untenable. We may fairly consider Kant's subjectivism as a thing of the past. And the agreement of the forms of objectivity with the forms of subjectivity is easily explained when we bear in mind that the thinking subject is a part of the objective world. It is but natural that the forms of existence are impressed upon the thinking subject as forms of thought.

Yet the question of the necessity and universality of the laws of form remains. Can we comprehend why the form of objective reality as well as of subjective thought must be such as they are, and might they not just as well be different? Is this question legitimate and can it be answered? We say Yes, the question is legitimate and can be answered.

All the laws of formal thought are products of thought-operations which are based on no other principle than that of identity ($A = A$). As soon as thinking beings have developed to that degree of thought-ability in which they are able to deal with the abstract idea of pure form, they can make constructions of pure forms. So long as these constructions of pure forms are made consistently and correctly (i. e. in strict agreement with the principle of identity), they will be found to hold good in reality and we can *a priori*—before we have made the actual experience—rely on their applicability.

The laws of pure forms (forms of thought as well as forms of existence) can satisfactorily be proved to anyone who acknowledges the principle of identity. The principle of identity is not an assumption but it is the generalised statement of the simplest thought-operation, which, if employed with consistency, can serve as a rule for other and more complex thought-operations. Consistency is the condition of thought. Consistency produces order, and order is the most characteristic feature of thought. We create some pure form in some definite way, for instance in counting we posit a unit (we call it "one"). Now we create in the same definite way again a pure form, we again posit a unit (we again call it "one"). In so far as these two "ones" are the product of the same operation they will be the same and we express this truth in the sentence $1 = 1$ or $A = A$.

When, for the sake of assistance in the process of abstract thought, we use real objects to represent our pure forms, similarly as an abacus is employed for assisting the young mind of a child in learning arithmetic, the dissimilarity of the objects is of no account. The proposition of their identity has no reference to the material objects, but to the operation. Two operations being according to some special and definite method exactly the same, their products are also exactly the same, and the rest is not to be minded, because we have in our abstraction purposely excluded everything else.

Here is not the place to show the palpable advantages of the methods of abstract thought and especially of the abstract thought-operations with pure forms. It is sufficient to characterise its main principle of procedure. We may also parenthetically remark that from our position we are no longer in need of axioms either in mathematics or in any other formal science. The data of formal sciences are certain mental operations, viz. positing pure forms, and combining, separating, and recombining them. The subject-matter of formal sciences consists in the products of these operations. To formulate some of the simplest products in axioms is a mistake which has been pointed out by Hermann Grassmann in his *Ausdehnungslehre.*

We are struck and overawed with the cosmic order of all natural phenomena which, as science teaches, is produced through the rigidity of the formal laws of existence. The planetary system with its regularity of motion which in spite of its many complications has been formulated by Kepler in most simple laws is an object of wonder to us. This order of nature is the same order as the grand harmony that prevails in mathematics and all the other formal sciences. The most complicated laws of both, forms of nature and forms of thought, are nothing but generalisations of special applications of the principle of identity in some kind of action that takes place. While the order of the objective world excites our wonder we can understand the order of the subjective world of thought-forms and know that, being the product of certain mental operations according to the principle of identity, it must be a matter of course. Thus the intrinsic necessity of the laws of our thought-forms gives us a clue to the intrinsic necessity of the laws of nature.

III. CONSERVATION OF MATTER AND ENERGY, AND CAUSATION.

The law of the conservation of matter and energy is nothing but an application of the principle of identity to nature as a whole. And the law of cause and effect is again a corollary only of the law of the conservation of matter and energy. The law of causation is a formula which maintains that there is identity in difference. Some motion produces a change of form. There is accordingly a different state after the motion than before. Yet the total amount of matter and energy remains the same. This is the identity in the change. David Hume and with him John Stuart Mill and the empiricists misunderstood the problem of causation. Instead of considering cause and effect as one continuous process that should be analysed, they considered cause and effect separately and attempted a synthesis. In addition to this mistake, causes as well as effects were defined to be objects. Hume says cause and effect are objects following one another. Cause however is a process; it is a motion, a change that takes place, an event that happens; it is not a thing. And effect is the product of such a process. Effect is a special form, a special state of things, a special configuration, but not the material of which this configuration consists. A certain poison introduced into the stomach of a living being produces certain motions in the bowels, called cramps, which may finally prove fatal. One change produces other changes and their product is a new state of things which is accompanied with pain and ends in death. It is wrong to call strychnine the cause and a dead mouse the effect. But if we call strychnine the cause and a dead mouse the effect, we must forever despair of solving the problem of causation by a reduction to the principle of identity, for strychnine is not at all identical with a dead mouse. No cause is the same thing as its effect, and we can by no means identify cause and effect. And yet the principle of identity holds good. The identity in causation is the conservation of matter and energy in a change of form.

It has been maintained that the law of cause and effect could never be proved; it is either an innate idea prior to experience (Schopenhauer and Schopenhauer's interpretation of Kant) or it is an assumption derived from experience of which (since experience is not as yet exhausted) we cannot know whether it will hold good forever (J. S. Mill). In contradistinction to these views we maintain, that the law of cause and effect can satisfactorily be proved to anyone who accepts the principle of identity. So far as the principle of identity is recognised, all the formal laws are unequivocally determined, or popularly expressed they are as they are, they will remain so and cannot be otherwise, they are necessary. All the determining factors and also the procedure of an operation are set forth, no unforeseen events are possible, for the non-formal elements are excluded, and therefore the result will be in one case just as it is in any other. Thus it can *a priori* be stated that formal laws will always hold good.

The question has been raised: Whether or not our knowledge of the apriority of formal laws is independent of experience. We answer: In a certain sense it is dependent upon experience, in another it is not. Historically and evolutionarily it is dependent upon experience. A store of innumerable experiences has to be gained before a rational creature will be able to make the abstraction of pure forms. As soon as this stage is attained, man possesses a world in himself. He can now experiment within himself with mental images, for instance with numbers; he can calculate. His mental operations with pure form are called "pure thought" and "pure thought" is now opposed to "experience through the senses." The word "experience" accordingly is used in two ways; it has a broad and a narrow meaning. In its broad sense it means any acquisition of knowledge generally, in its narrow sense it means knowledge acquired through the sense-activity alone. Our knowledge of the apriority of formal laws rests upon experience in its broad sense, but not upon experience in its narrow sense. We can never derive the idea of necessity from sense-impressions. John Stuart Mill in rejecting innate ideas saw no other way than to derive the formal laws from experience (taking here experience in the broad sense). Yet he did not make a distinction between formal thought and sense-experience. He considered the nature of sense-experience as typical for all experience. And thus, again, taking experience in the narrow sense of the term, he was from his premises perfectly justified in rejecting the idea of necessity. If the process of cause and effect is really a synthesis of two things represented in two different sense-impressions following each other, then indeed we have no guarantee that the same sequences will always be observed; and there may be worlds in which the law of causality does not operate. Mill saw all the consequences of his mistake, he conceded freely that we are not justified in assuming that twice two will always be four: many thousands of experiences are in its favor, but we cannot be at all sure that no case will ever happen in which twice two makes five.

The ideas of causality and of the conservation of matter and energy are not derived from experience in the narrow sense of the word, not from sense-experience, but from experience in the wider sense of the word, i. e. from sense-experience arranged with the assistance of formal laws. We should not forget that mere sense-experience exists only in our abstract thought. In reality all sense-experience is relational, it is inseparable from its form. Form and the laws of form are not something purely mental which is transferred to the world of reality, form is something real, it is objective, it is a quality of the facts and the thought-forms of mind are a part and a product of the formal structure of the universe.

The ideas of causation and of the conservation of matter and energy are not prior to experience, they are a part of experience, i. e. experience in the wider sense. They are not part of the sense-experience, but the results of our experiments with purely formal thought-operations, and being the vital instrument or organ of cognition they are the condition of all methodical experience.

IV. WHY IS MR. MILL'S PROPOSITION UNTENABLE?

In practical life we all expect that 2 × 2 will under all circumstances make 4, and not 5. We reject Mr. Mill's idea that there may be even a possibility of the latter. Is our expectancy really due to *a posteriori* experience which having been repeated so often in the lives of our ancestors is now so firmly rooted in our minds that we imagine it to be necessary and *a priori*? No! certainly not. The experiences of our race in the struggle for life has produced our ability of thought, but it has nothing to do with the apriority of the products of formal thought-operations. A statement of formal thought such as "twice two makes four," cannot be compared to statements of sense-experience such as that sugar has a sweet taste. There may be a moment in which the taste of sugar will be bitter to our tongue. This is quite possible. But to say that twice two might in the future or in any other world, as Mr. Mill maintains, make five is nonsensical, and the possibility of this assumption cannot be placed in one line with the possibilities of extraordinary and exceptional sense-experiences.

What does "twice two makes four" mean? Two means 1 + 1, and twice two means 1 + 1 plus 1 + 1. This sum is called "four"; and what we call five is 4 + 1. To maintain that the operation 2 × 2 might produce the result 5, is to admit conditions which have been excluded. Pure forms are not like animals which multiply; they are and remain such as they have been posited. When we put two amœbas into a glass and then add two other amœbas, it is quite possible that in the mean time one of the first set has divided into two. In that case we would have five amœbas. But the operation 2 × 2 cannot breed any additional units, so as to produce a greater number than the sum of 1 + 1 + 1 + 1. Nor can we let any of these units disappear into naught, so as to produce the result 3, without committing some inconsistency in our thought-operations, for the products of our thought-operations are rigid and must remain such as they have been posited. They are not animals blessed with fertility but pure forms and nothing but pure forms.

How could Mr. John Stuart Mill overlook so palpable a contrast as that between formal knowledge and sense-experience? He was apparently prejudiced against the term "a priori," which as we freely confess is a very poor and inadequate expression. Mr. Mill himself states the cause of his prejudice in his autobiography. He says:

> "There is not any idea, feeling, or power, in the human mind, which, in order to account for it, requires that its origin should be referred to any other source than experience."

Mr. Mill was justly exasperated against anything *a priori*, for in his time, it had become customary among certain philosophers to classify all pet superstitions which could not be proved by experience as a priori. Mr. Mill continues:

> "Whatever may be the practical value of a true philosophy of these matters, it is hardly possible to exaggerate the mischiefs of a false one. The notion that truths external to the mind may be known by intuition or consciousness, independently of observation and experience, is, I am

persuaded, in these times the great intellectual support of false doctrines and bad institutions. By the aid of this theory every inveterate belief and every intense feeling, of which the origin is not remembered, is enabled to dispense with the obligation of justifying itself by reason, and is erected into its own all-sufficient voucher and justification. There never was such an instrument devised for consecrating all deep-seated prejudices."

We appreciate the cause of Mr. Mill's prejudice, but we cannot agree with him. And Mr. Mill is mistaken when he imagines that a rejection of apriority will abolish false doctrines and superstitions. On the contrary. The recognition of absolute necessity based upon the universality of formal thought will alone be a safe basis of science through which we can reject *prima facie* the wrong pretensions of superstitions and pseudo-science. If we assume with Mr. Mill that all formal knowledge partakes of the nature of sense-experience, that there is no difference between the two, no general judgment would be allowable and the idea of necessity would be inadmissible. These consequences are accepted by Mill. In that case science would lose its value and philosophy would be without foundation. The most absurd superstition could not be rejected off-hand on the ground of being contrary to that which through logic and other formal sciences has been found to be necessary and a condemnation of any superstition on the part of science would be mere arrogance. Pseudo-science would have the same right with true science.

It is obvious that without being obliged to consider the apriority of formal laws as innate, we need not accept the consequence of Mr. Mill's philosophy. We can and we do retain the idea of necessity and we consider it as the corner-stone of all science.

V. THE MEANING OF "NECESSARY."

We have to be on our guard lest we introduce some mystical element into the idea of necessity. There is nothing mystical about necessity. Necessary means that a certain operation, if it is exactly the same operation as another one, will produce exactly the same result. When we posit two units twice, we shall have the same result as when we posit one unit four times ; and we call this result four. We shall reach the same product whenever we repeat the same operation. Knowing that we shall always reach the same result, we can, *a priori* (or beforehand) and with certainty, determine the result of certain operations after we have mentally gone through the same operations for all possible cases and under any imaginable conditions. That a perfect apriority with an unfailing certainty is possible only in the domain of formal thought is natural. The reason is that we know our thought-forms exhaustively. They contain nothing but that which has been predicated about them. Our sense-experience however is always piecemeal and never exhaustive.

Comprehension is actually a tracing of form relations and a formulating them in concise statements. The scientist's work is based upon the methods of measuring and counting (i. e. the methods of formal sciences) and he undertakes to show that certain phenomena, different in some respects, are the same in other respects, that their sameness can be stated in a comprehensive and exact formula. In this way he marks out their determining factors in terms of formal thought (for instance in numbers), so that we can compute them and predict them according to their determining factors, so that we can know, according to their conditions, that they will be always as they are.

The importance of formal thought is paramount in science and the problem about the necessity which attaches to the laws of formal thought is the fundamental problem of philosophy.

There are many philosophers, still, troubling themselves to solve the problem in the fashion of Schopenhauer or of Mill or looking upon the problem as insolvable. We do not doubt that the solution here presented is the only possible solution which as soon as it is understood will find a general acceptance.

Must it be added that the solution of this fundamental problem does not involve the ready solutions of all other minor problems? Oh no! We all know that the solution of one problem is only a stepping-stone for attacking other problems. The possibilities of progress are as unlimited as the scope of cognition. Light on this general subject gives us hope that we shall succeed in throwing light also upon other subjects which are still shrouded to the philosophical inquirer in impenetrable darkness.

VI. MODERN LOGIC.

The problem of modern logic is at bottom no other problem than that of formal thought and of the origin of thought-forms. Professor Dewey in the excellent essay which appears as the leading article of this number says: "Any book of logic will tell us what this conception of thought is: that thought is a faculty or an entity existing in the mind apart from facts and that it has its own fixed forms with which facts have nothing to do—except in so far as they pass under the yoke." This is the old conception of thought, rightly criticised by Professor Dewey, for, closely considered, it turns out to be dualistic. However, as soon as a proposition is recognised to contain or to rest upon dualism, it becomes a problem. The problem of modern logic is, How can we arrive at a monistic conception of logic, how can we rid ourselves of the dualism on the one side of facts not yet rationalised by the method of thought-forms and on the other side of mind with its empty thought-forms assimilating facts to its own nature.

Our solution of the difficulty has been proposed, in the sense outlined by Professor Dewey, in "Fundamental Problems." Professor Dewey, according to our opinion, is right when he says there is no such a thing as transcendental thought, or pure thought, thought by itself. And there is no such a thing either as fact, crude irrational chaotic fact. The world of fact, indeed, is a cosmos and no chaos; there never was a chaos and never will be a chaos, for the laws of form are an essential and the most characteristic feature of the world.

Can there be any question how the order found in thought-forms originates in a world in which the inorganic and unfeeling mineral crystallises in a regular shape according to strict mathematical laws, i. e. the laws of form? A world in which the plant grows not otherwise than according to strict mathematical laws building up roots and stem and leaves and petals and stamens and all other organs obedient to a certain plan which will vary according to circumstances, but throughout consistent with the principles of formal laws? Can there be any question that in this world of cosmic harmony thought-forms will develop in feeling beings as a microcosm exhibiting the same regularity and conformity to law as do in this world all other things animate and inanimate? Our pure, i. e. merely formal, thought is an abstraction which serves the purpose of comprehension. And so is the concept "matter," being that which produces sense-impressions. There are no such ghosts as pure matter or pure thoughts in reality.

Modern logic, so far as we conceive it to be right, is by no means an overthrow of the old formal Logic, generally called Aristotelian. It is simply an amendment made in order to exclude an erroneous interpretation. And so is modern mathematics not so much a revolution as an extension of the old Euclidian system. It is a revolution only against a certain unclear conception of mathematics according to which this science is said to rest upon axioms, these axioms representing absolute truth—unprovable, incomprehensible, and mysterious.*

The main truth of monism is that reality forms one indivisible whole and all our concepts are mere abstractions representing certain parts or certain features of the whole. As soon as we try to think of any of them as things in themselves we become involved in inextricable contradictions. It appears as if the formal sciences contained some truths which were absolute and independent of actual reality. But let any one think of any number, of 2 or 3, and he will soon find that conceived as absolute beings they are meaningless and unthinkable.

This is not to say that numbers are phantoms, but that conceived as absolute beings they are phantoms. Numbers and all formal concepts represent something real, they represent pure forms. And form is as much a part and feature of reality as is matter and energy.

P. C.

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* Hermann Grassmann, one of the founders of modern mathematics, has called attention to the fact that Euclid had a clearer conception of the fundamental concepts of mathematics than his ill-informed translators and interpreters. Grassmann says in his *Ausdehnungslehre*: "From the imputation of confounding axioms with assumed concepts Euclid himself, however, is free. Euclid incorporated the former among his postulates (αἰτήματα) while he separated the latter as common concepts (κοιναὶ ἔννοιαι)—a proceeding which even on the part of his commentators was no longer understood, and likewise with modern mathematicians, unfortunately for science, has met with little imitation. As a matter of fact, the abstract methods of mathematical science know no axioms at all."—Quoted from *The Open Court*, Vol. II. No. 77, *A Flaw in the Foundation of Geometry*, by Hermann Grassmann, translated from his *Ausdehnungslehre* by μκρκ.